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Minerals in Canada

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Minerals in Canada

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The Canadian mineral industry showed moderate growth in 1983 with an increase of output valued at \$2.2 billion.

The total value of mineral output of the four sections of the industry — metallics, non-metallics, structural materials and fuels — reached almost \$36 billion, compared to \$33.8 billion the previous year. Metallics, which showed a 20 per cent decrease in 1982, reached \$7.2 billion in 1983, an increase of 5.3 per cent. Output for non-metallics and structural materials totalled \$3.6 billion, down slightly from the previous year's figure. Fuels, by far the largest of the four sections, reached \$25 billion, an increase of 8 per cent over the 1982 level.

The ten leading minerals in 1983 were: petroleum, natural gas, natural gas byproducts, copper, coal, gold, iron ore, zinc, nickel and cement. All except natural gas, iron ore and cement increased the value of output in comparison to that of the previous year.

Canada is ranked third among world producers of minerals and first among exporters. The country's material stability is based in part on minerals, which are an important asset to the economy and contribute greatly toward Canada's standing internationally. Minerals and their derivatives are directly involved in the production of concrete and steel bridges, automobiles, construction materials, coins, telephones, metal containers and thousands of other durable or disposable items.

A main reason for Canada's leadership in world markets has been brought about by the efforts of the mineral industry work force — the research and exploration teams, those who work underground or in refining, as well as those who are involved in activities related to the industry, such as financing, transportation, marketing and technology. In fact, the mineral extraction and processing industries employ some 140 000 Canadians and provide related employment for another 600 000.

As the leading mineral exporter, Canada sells about 80 per cent of its production in both raw and processed forms to some 100 markets. Nearly all exports are processed into concentrates, many of which are smelted and refined.

While mineral exports increased at an annual rate of 5.1 per cent in real terms from 1962 to 1981, the continued progress of the mining industry depends greatly on the expansion of foreign markets. The United States absorbs 50.9 per cent of Canadian crude mineral exports, Japan 12.9 per cent, the European Community 10.3 per cent, Britain 5 per cent and other nations 20.9 per cent.

Many countries not only purchase Canadian minerals but also seek Canadian technological knowledge in mining development, which is widely recognized for its quality and innovativeness.

Mining in Canada: Facts and Figures, published in 1983 (pages 7 and 8), describes as follows, Canada's role in the development of its mining industry:

"Over the years, advancing technology has had a dramatic impact on mining — in reducing costs and increasing supply at all stages of exploration, development, production and marketing. As a result of innovative technologies, there has been a substantial increase in the recovery rate of metals and byproducts from the processing of ores, scrap metal and tailings.

"Other applications which have reduced costs include more efficient flotation techniques for extracting minerals, while large-scale mechanized equipment has now made low-grade open-pit mining economical.

"The industry also conducts important research into ways to improve health and safety. For example, the Mining Industry Research Organization of Canada (MIROC) carries on continuous programs to develop better equipment for miners. . . . In addition, the organization is currently examining the effectiveness of a new air-flow monitoring system that measures the movement of fresh air underground.

"Minerals are an integral part of the environment and their extraction and processing inevitably causes some disturbance. The industry, however, is committed to minimizing that disturbance. Environmental protection accounts for an average of 10 to 15 per cent of total expenditures for new Canadian mining and processing operations. All plant designs incorporate proven methods to reduce [the formation of] pollutants in water, air and land.

"The industry's efforts in research and development are coordinated with important programs developed by specialized government agencies. Most notable is work with the Canada Centre for Mineral and Energy Technology (CANMET), which is part of the federal Department of Energy, Mines and Resources."

The mining industry has also been instrumental in the development of transportation in Canada as railways and the St. Lawrence Seaway

have to accommodate the immense quantities of crude and processed minerals transported each year across the country *en route* to shipping ports.

The geological regions of Canada

Canada has five main geological regions: the Canadian Shield, the Interior Plains, the Cordilleran Region, the Appalachian Region and the Innuitian Region.

The Canadian Shield, the country's main physiographic feature, consists of an enormous expanse of rock over three billion years old rising above ground level in some places and in others covered with bush and bog. It includes almost half the country's surface, occupies most of eastern and north-central Canada and forms a broad band around Hudson Bay. The Shield is also one of the world's mining regions and one of the most mineral-rich areas in Canada, containing mainly nickel, copper, gold, silver, cobalt, zinc, iron and uranium.

The Interior Plains region is a vast flat land extending west from the edge of the Canadian Shield to the foothills of the Rocky Mountains. It is the centre of considerable agricultural activity as well as mining. The Plains Region is Canada's primary producer of fossil fuels, but non-metals such as potash, gypsum and salt are also extracted.

The hilly Appalachian Region, located southeast of the Canadian Shield, encompasses the Atlantic provinces and part of southeastern Quebec. It contains copper, zinc and lead mines and large deposits of coal. The world's largest asbestos mines are found in the Quebec sector of the region.

The Cordilleran Region, part of the Pacific belt, is characterized by the spectacular mountain chains of the West. It covers British Columbia and the Yukon Territory. Mining activity is intense in this region. Copper, lead, zinc, asbestos, iron ore, molybdenum and tungsten are produced.

The Innuitian Region, named after the Inuit word for "man", comprises the northern islands of the Canadian Arctic. Recent exploration activities in this inhospitable area have indicated extensive oil and natural gas deposits and large deposits of zinc and lead. In 1982, 160 000 tonnes of lead-zinc concentrates were shipped from the Polaris mine. Interest in mineral exploration in this part of the country is on the increase.

Major Canadian non-fuel minerals

Copper

The most important properties of copper are its ability to conduct electricity and heat and the ease with which it can be combined with other metals to produce a host of useful alloys. Copper is alloyed to increase its hardness and resistance to corrosion or to make it more workable. The heaviest consumption of copper occurs in the fields of electricity and communications and in the brass industry.

Canada ranks fourth in world copper production. The major producing regions are in Ontario, Quebec, British Columbia and Manitoba.

In its natural state, Canadian copper is frequently associated with other non-ferrous metals such as nickel, zinc, lead and molybdenum. Much of Canada's production comes from deposits in which the average ore-grade is 2 per cent copper, or 20 kilograms of copper *per* tonne of ore.

About 500 000 tonnes of copper are refined in Canada annually. More than half is exported, principally to Europe and the United States. The unrefined copper is also exported, in the form of concentrates, to Japan, Europe and the United States.

Copper smelting and refining will increase in Canada and the proportion of minerals exported in the form of concentrates will decrease. In addition, domestic consumption has increased since copper-bearing metals have been used to advantage in the nuclear energy sector and in the relatively new field of solar energy conversion.

Gold

Gold is best known for its use in jewellery and commemorative coins and medallions. However, it has a number of industrial applications, some of which are highly specialized. Gold and its alloys are commonly used in dentistry, electronics and the aerospace industry. Although it ceased to be used as the official monetary reserve after 1978, its use as a guarantee for loans between countries has increased.

Canada is one of the main producers of this precious metal, ranking third after the Republic of South Africa and the Soviet Union. In 1982, 39 lode-gold mines were being operated by 30 companies. Quebec is now the main gold-producing province, followed by Ontario and British Columbia.

Of the 52 million grams of gold produced annually in Canada, 73 per cent comes from lode-gold mines and placer deposits, and 27 per cent

from the treatment of base-metal ores. The gold is sent in the form of ingots of impure gold to the Royal Canadian Mint or to a private refinery, where it is again refined until it reaches a degree of purity as high as 99.999 per cent. It is then sold and used in various ways.

Despite price fluctuations, gold mining is still a viable undertaking. There is no longer much likelihood that world production will decline; on the contrary a slight increase is expected.

Iron ore

Iron is the main component of steel, which is the basic metal of every industrialized society. In fact, the construction, automobile and aeronautical industries alone consume 40 per cent of the steel sold on the national market. Another important segment of this market is piping, which represents 15 per cent of the demand. Also important is the manufacture of special steels, such as stainless, tool quality steel and high performance steel, used in the aerospace and armaments industries and in nuclear energy applications.

Canada is a major world producer and exporter of iron ore, ranking sixth in volume of production. The Labrador area of Newfoundland is Canada's largest source of iron ore, followed by Quebec, Ontario and British Columbia.

Iron ore is usually found near the surface, and the mines are normally open pit. The crude ore is then processed to produce an enriched concentrate containing approximately 65 per cent iron, instead of the 35 per cent normally contained in the crude ore. The Canadian steel industry usually operates at about 90 per cent of its capacity and has pioneered technologies such as the basic oxygen furnace, continuous casting and direct reduction.

One of the country's largest markets for iron ore is the steel industry, which absorbs one-quarter of the production. Of the remaining 75 per cent of the average annual production of some 45 million tonnes, approximately 33 per cent is exported to the United States, and the rest to Britain, Western Europe and Japan.

It is estimated that by 1985 Canada's yearly iron ore production will reach 60 million tonnes.

Lead

Lead has a very long life since, of all the common metals, it is the most corrosion-resistant. Its uses are many and varied. For example, it is used to manufacture lead-acid batteries and ammunition, as a construction



The principal mining areas of Canada

Producing areas

Metals

- ① copper, copper-zinc
- ② nickel-copper
- ③ iron ore
- ④ iron ore — titania
- ⑤ lead-zinc-silver (copper)
- ⑥ silver

- ⑦ gold
- ⑧ uranium
- ⑨ molybdenum
- ⑩ tungsten
- ⑪ niobium (columbium)
- ⑫ tantalum
- ⑬ mercury
- ⑭ cobalt

Non-metals

- △15 asbestos
- △16 potash
- △17 gypsum
- △18 salt
- △19 coal
- △20 nepheline syenite



material and to provide protection around X-ray equipment and nuclear facilities.

Canada is one of the world's largest producers of lead, ranking third after the United States and Australia.

Nearly all lead is obtained from sulphurated ores, the most common of which is galenite. It is usually found in conjunction with other sulphurated ores, most frequently zinc and often copper. Consequently these co-products are generally extracted and concentrated. Lead is different from most other common metals in that considerable quantities of it are produced by recycling (scrap iron and old automobile batteries in particular). This is known as secondary production.

Some 80 per cent of the lead produced in Canadian mines is exported to other countries. Canada's biggest customers for lead ores and concentrates are Japan, the United States and West Germany. The United States and Britain purchase most of the refined lead.

Programs to reduce production costs in Canadian lead mines and refineries have already been included in business strategies. In this way Canada's lead ore will continue to be processed without interruption.

Nickel

Nickel is used mainly as an alloy to give strength, hardness and corrosion resistance to other metals. There are in fact more than 3 000 nickel-base alloys, each used for particular purposes. For example, nickel is combined with chrome and alloyed with steel to produce stainless steel, at present one of the world's most valuable materials.

Canada ranks first among nickel producing countries and supplies about 30 per cent of world demand. The largest deposits of nickel discovered so far lie in the Sudbury basin in northern Ontario.

The nickel extracted in Canada is found in combination with various quantities of sulphur, iron and copper, and small quantities of other minerals. The ore has a crystalline structure and is a sulphide. The sulphurated ores are usually found in deep veins and are most often recovered by the underground extraction method.

Refined nickel is exported to 40 countries. The major customer for Canadian nickel is the United States. The other main purchasers are Finland, the Benelux countries, Britain and Japan.

Nickel plays a key part in the energy, aerospace, transportation, chemical and industrial processing industries, as well as in mining operations and agriculture. These are sectors that should expand considerably in the future; thus nickel consumption for the coming decade should increase at an average annual rate of 2 to 4 per cent.

Silver

In view of its qualities and its relative scarcity, silver is classified as a precious metal with gold and platinum. Owing to its superiority as a conductor of electricity, more than 25 per cent of all industrial silver is used for the production of electronic and electric equipment, and in the manufacturing of highly developed equipment such as satellites, space craft and guidance systems. However, the largest quantity of silver — nearly 40 per cent of total industrial production — is consumed by the photography industry. Numismatic and commemorative pieces are the only coins in which silver is used today.

With an average annual production of some 1 200 tonnes, Canada is the world's third producer of silver. The main regions in which it is mined are Ontario, the Yukon, British Columbia and New Brunswick.

The principal sources of silver in Canada are the base-metal ores, mainly those containing copper, lead and zinc, either in the secondary or complementary form. Consequently, only a small proportion comes from silver-cobalt ores and lode and placer gold ores.

The United States is by far the largest importer of Canadian silver, absorbing 73 per cent of total exports, while the remainder is shipped to Japan, Belgium and Luxembourg.

In the short and medium term, Canadian production of silver should remain near the current level. It is not believed that the new electronic technology being used in photography will reduce the quantity of silver used in this field.

Zinc

Zinc, one of the most useful metals in modern society, is used mainly for plating iron and steel to increase their resistance to rust and corrosion by a process called galvanization. Galvanized products are used extensively in the building and automobile industries. Another important use of zinc is in the production of a wide range of products molded under pressure. Finally, zinc is used in the manufacture of brass, an alloy of copper and zinc, which has good physical and electrical properties and which conducts heat and resists corrosion.

Some 25 per cent of all zinc used in the Western world is produced by about 30 Canadian mining operations. Their output of more than a million tonnes of zinc a year, makes Canada the world leader in this metal.

In the ground, zinc is usually mixed with copper or lead or with both. The ore is then separated in different metallic concentrations by the flotation method. Canadian zinc concentrates have a metal content of 48

to 60 per cent, depending on the ore. Canadian zinc is obtained by the use of electrolysis, which refines the product to more than 99 per cent pure.

Canada exports over 90 per cent of its zinc. The United States consumes more than 70 per cent of the refined zinc exports. Britain, Pakistan and Venezuela are also important customers. Belgium purchases more than 45 per cent of the zinc concentrate and Japan 20 per cent. The United States and West Germany are also important purchasers of Canadian zinc concentrates.

Canada welcomes the prospect of a 3 per cent annual increase in the world demand for zinc during the Eighties. Not only does it have the resources required to maintain its traditional share of this growing market it is even hoping to expand it.

Asbestos

The fibrous mineral, asbestos, is known mainly for its resistance to fire. It has over 3 000 industrial uses, such as the manufacture of automobile and aircraft brake linings. About half the world production of asbestos is used in the manufacture of fibro-cement products for the construction industry.

Canadian exports of asbestos fibre represent about half the total world exports. Canada provides 24 per cent of the world's supply of this mineral and ranks second, behind the Soviet Union, in extraction and processing.

The West's largest deposit is found in Asbestos, Quebec, where the formation of this mineral dates back over 400 million years. Quebec continued to produce 85 to 90 per cent of the Canadian total each year.

Over 95 per cent of the annual asbestos production is exported to 70 countries. The United States is the main importer of Canadian asbestos, and other customers include the Federal Republic of Germany, Japan, Britain, France, Australia and Spain.

Asbestos will undoubtedly continue to be important economically since a substitute is unlikely to be found in the near future. Moreover, industry considers the supervision of its use to be pragmatic and generally acceptable.

Potash

The world fertilizer industry consumes some 26 million tonnes of potash a year. A certain amount is also used in the manufacture of soap, detergents, glass, ceramic products, dyes, explosives and medicines.

Canada, ranking second to the Soviet Union, produces nearly eight million tonnes of potash yearly, all of it in Saskatchewan.

The deposits in Saskatchewan, where according to the present estimates, more than 50 per cent of the world's reserves are found, are flat and the "chamber-and-pillar" method of extraction is used. The ore is extracted by large excavators and is then ground into fine particles. The potassium chloride is recovered by flotation.

Canada exports as much as 95 per cent of the potash produced in Saskatchewan. The United States absorbs 70 per cent of it, and most of the remainder is sent to Japan, Korea, Brazil, China, India and Australia.

Despite annual fluctuations, it is expected that the world demand for potash will increase in the coming years at an annual rate of 3 to 4 per cent. Thus Canada will continue to expand its existing mines and will open new ones, mainly in New Brunswick.

Aluminum

The usefulness and adaptability of aluminum make it perfectly suited to the needs of the construction and transportation industries, including the aeronautical industry, because of its excellent resistance-weight relationship. In addition, the food industry relies heavily upon aluminum containers and foil, because aluminum is chemically very stable and does not react to foods.

Canada is the world's fourth producer of aluminum ingots. Quebec has about 75 per cent of Canada's foundry capacity, and British Columbia about 25 per cent.

Aluminum is the only metal produced in Canada that is not derived from Canadian ore. Before the aluminum for world markets can be produced, Canada must import the bauxite or refine alumina and then process it. The aluminum industry requires much electricity and has been established in Canada because of the abundant, economical sources of hydroelectric power available here.

Canada is the world's main exporter and ships 60 per cent of all the aluminum, from the first stage of refining, to the United States. Japan is the second-largest buyer, followed by China, Israel, Thailand and Brazil.

Over the next ten years, it is expected that the consumption of aluminum will increase on an average of slightly less than 4 per cent yearly. This forecast is welcomed by the Canadian aluminum industry, since the low cost of electricity here will encourage the construction of aluminum and electrolysis plants. The continuing demand in the packaging, trans-

portation and construction industries will provide new outlets for the metal, both in the developing countries and in the industrialized ones.

The future

The Canadian mining industry faces a considerable challenge in the future. If mineral resources are to continue to be vital in the growth of the economy and to contribute to the country's prosperity, it is essential that the long-term exploration program be intensified. Thus the development of new prospecting techniques will lead to the discovery of new deposits in geological environments once considered to be sterile, and in the northern regions, where undiscovered riches lie. In addition, more thorough exploration is required in the marine regions of Canada to discover the resources in the seabed.

Efforts will be made to develop new techniques to work deposits that were formerly considered no longer minable, and to recover metals from fragments. Technological development might well lead to the discovery of new uses for products which today are considered worthless. And since most of the ores are exported in crude or partially processed form, Canada will seek to further develop its processing operations.

As a main exporter of minerals, Canada must increase its contribution to international planning for mining development and to the exchange resulting from such planning. In short, with some effort Canada should be in an excellent position to remain one of the world's major producers of minerals. With a favourable economic situation, its mining industry should remain strong and competitive internationally.



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